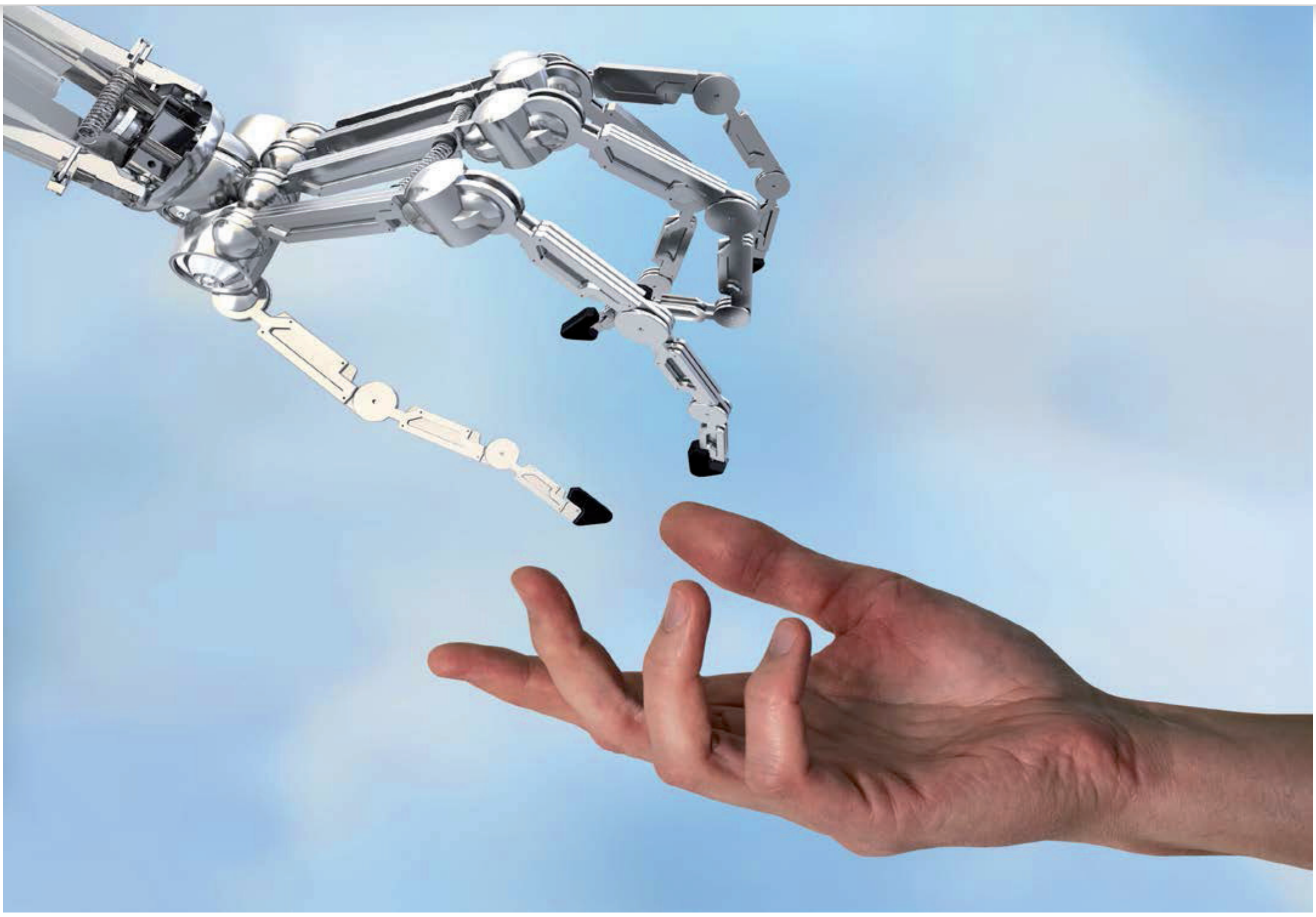
OMRON

Collaborative Robots

Risk Assessment



Safe Applications

- Requirements
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WHITEPAPER

Description

The safety standard defines **collaborative robot** as a robot designed for direct interaction with a human within a defined collaborative workspace.

The **collaborative workspace** is the space within the operating space where the robot system and a human can perform tasks concurrently during production operation. This encompasses the robot system, which includes the work-piece, end-effector, fixtures and any device controlled by the robot.

More information can be found in the Technical Specification TS 15066 and the Industrial Robots and Robot Systems – Safety Requirements standard ISO 10218 parts 1 &2 / ANSI RIA15.06-2012. ISO 10218 parts 1 & 2 and ANSI RIA15.06-2012 are harmonized standards, with differences only being minor grammatical changes.

Requirements

A risk assessment is required for all industrial collaborative robot systems.

The integrator is responsible for completing the initial risk assessment. There should be special consideration for situations when there can be contact between the robot and operator(s).

The end user should participate in the initial risk assessment process and is responsible for maintaining the information and making

Tasks related to the collaborative workspace may require additional and new considerations.

Risk assessment determines if safety controls, hard guarding, etc. are needed for unauthorized people, auxiliary machines, and non-collaborative processes.

More information about risk assessment responsibility is listed in the ISO 10218 / ANSI RIA 15.06.

Task Identification

During task identification, other drive -power hazards can still exist even if the robot is not moving. Things to consider may include:

- How long and how often the operator is in the collaborative workspace.
- What is the potential frequency and duration of contact between the operator and the robot? A collaborative robot application should be reconsidered or redesigned if there is a high potential for head or neck contact.
- A new consideration is what happens during the transition into or out of the collaborative workspace.
- If more than 1 operator will work with the collaborative robot or be able to access the collaborative workspace, sensing devices to monitor additional individuals may need to be evaluated.
- If additional tasks are defined, they may require additional hard guarding or safeguarding.
- Potential pinch points and crushing due to other structures may require additional safeguarding or layout redesign.
- Determine what out-of-the-ordinary events would require a manual restart.
- Do different levels of drive power have different levels of hazard? For example auto mode and logic power.

Note: Each application is unique and may include topics not listed.

Hazard Identification & Risk Reduction

Non-robotic and machine hazards once contained by safeguarding with traditional robot systems may be exposed during collaborative operation. Additional consideration should be made to design out or use alternate solutions for end-of-arm tooling, part orientation and fixturing. Things to consider may include:

- Are there extreme temperatures capable of causing injury to the operator if contact is made? An example may be a hot glue gun A design consideration could be a cover to protect the operator from having access to the hot part or changing the orientation so the hot part is away from the operator and would be difficult to reach during normal operation.
- If the part became dislodged from the end-of-arm tooling, could the impact injure the operator? A design consideration could be to add redundant mechanisms to detect and further reduce the uncontrolled loss of the part.
- If clamping forces on the end-of-arm tooling or fixtures can cause an injury, can the force be reduced? Design considerations could be to open and close clamps when the operator is outside the collaborative workspace or using clamps capable of retracting if excessive force is detected.

- Can exposure to sharp edges cause cuts and abrasions? These could be reduced by using rounded edges, more compliant, softer materials, and wider contact surface areas.
- How can the robot characteristics and operator location be changed to reduce potential unacceptable contact risks? If the robot has unexpected starts capable of startling the operator, indicators or operator initiated start function could be used.
- Consider the operator's motion for all tasks, including the unexpected ones (such as dropped parts). How can they change based on conditions such as fatigue, stress, capability, reflexes, and interruptions?
- Can personal protective equipment affect how operator works? Could gloves or clothing get caught in clamping fixtures and prevent the operator from escaping a hazardous robot motion or accessing an emergency stop?
- Is the operator in close proximity to an application requiring shielding, such as welding sparks or a laser cutter? Could exposure to those hazards be further reduced by changing thelayout design so the operator does not have access or by adding safeguarding?
- Is the transition between the collaborative and non-collaborative workspaces defined, understood by the operator(s), and controlled?

Notes for Hazard Identification and Risk Reduction

Risk reduction measures may not provide adequate protection.

Risk reductions in traditional systems are done through safeguarding. With collaborative applications, risk reductions include the robot's design.

Protective measures are anything preventing personnel injuries from the hazard(s), such as stopping, limiting forces, and limiting speeds. An example of limiting speed may be done with an area scanner that would send a signal to the robot to reduce its speed as the operator approaches. Difference is slowing down the robot speed instead of stopping it.

Supplementary protective measures are devices such as signs and training.

The hierarchy of control chart may not be applicable for all collaborative applications.

Use safety rated soft axis and space limiting when practical. Protective measures determined by the risk assessment shall be provided.

Crushing hazards should be eliminated or safely controlled. The clearance is the same as ISO 10218 / ANSI RIA 15.06 (20 inches, 500 mm) or protective measures are to be used, but those could be different than traditional robot use. Additional requirements are in the speed and separation monitoring and power and force limiting sections of the TS 15066.

Determine the transition time limit between the collaborative operations and when the safety controller resumes stopping control. Consult ISO 12100 for more information.

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